IN THE CLAIMS:

The claims will appear in the reissue patent as follows (the numbering of the new reissue claims added to original patent claims 1-23 has been preserved for ease of reference):

[1. An apparatus for supplying regulated voltage d.c. electrical power to an LED array comprising:

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correction converter means (38) having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output; and

an LED array (12) having an input connected to said output of said power factor correction converter means (38) for receiving said regulated voltage d.c. power to illuminate said LED array (12).]

[2. The apparatus according to claim 1 wherein said power factor correction converter means (38) is a power factor correcting and voltage regulating buck/boost switchmode converter.]

[3. The apparatus according to claim 1 including a pulse width modulated modulator means (46) connected to said output of said power factor correction converter means (38) and to said input of said LED array (12) for modulating said regulated voltage d.c. power.]

[4. The apparatus according to claim 1 including an electromagnetic interference filter means (28) connected to said input of said rectifier means (32) for preventing conducted interference from feeding back onto a.c. power lines (22) connected to said rectifier means input.]

[5. The apparatus according to claim 1 including an adaptive clamp circuit means (24) connected to said input of said rectifier means (32) for eliminating leakage current problems.]

[6. The apparatus according to claim 5 wherein said adaptive clamp circuit means (24) has an input adapted to be connected to a pair of a.c. power lines (22), a pair of clamp circuit output lines (26) connected to said adaptive clamp circuit means input, a voltage sensing means (48) connected across said input of said adaptive clamp circuit means (24), and a controlled load means (50) connected across said clamp circuit output lines (26) and to said voltage sensing means (48). said voltage sensing means (48) being responsive to a magnitude of a.c. voltage at said adaptive clamp circuit means input lower than a predetermined magnitude for turning on said controlled load means (50) to connect a low impedance load (60) in said controlled load means (50) across said clamp circuit output lines (26) and said voltage sensing means (48) being responsive to a magnitude of the a.c. voltage at said adaptive clamp circuit means input equal to or greater than said predetermined magnitude for turning off said controlled load means (50) to disconnect said low impedance load (60) from said clamp circuit output lines (26).]

7. <u>An</u> [The] apparatus [according to claim 1 including] <u>for supplying regulated voltage d.c. electrical power to an LED array comprising:</u>

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correction converter means (38) having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output;

an LED array (12) defined as consisting of series-parallel connected LED devices, having an input connected to said output of said power factor correction converter means (38) for receiving said regulated voltage d.c. power to illuminate said LED array (12); and

a battery backup means (62) having an input for receiving a.c. power applied to said input of said rectifier means (32) and having an output at which d.c. power is generated, and a switch-over means (82) connected to said output of said battery backup means (62) and to said rectifier means input, said battery backup means (62) being responsive to a failure of a.c. power at said battery backup means input for controlling said switch-over means (82) to connect said output of said battery backup means (62) to said input of said rectifier means (32) to provide d.c. power to illuminate said LED array (12) and being responsive to a.c. power at said battery backup means input for controlling said switch-over means (82) to disconnect said battery backup means output from said rectifier means input.

8. The apparatus according to claim 7 wherein said switch-over means (82) is an electromechanical relay.

9. The apparatus according to claim 7 wherein said battery backup means (62) includes a time delay and restoration means (78) responsive to application of a.c. power at said input of said battery backup means (62) for controlling said switch-over means (82) to disconnect said output of said battery backup means (62) from said input of said full wave rectifier means (32) and connect the a.c. power to said full wave rectifier means input after a predetermined time delay.

10. The apparatus according to claim 7 wherein said battery backup means (62) includes a d.c. power switch-over and flasher means (80) connected to said switch-over means (82) for pulsing said d.c. power at a predetermined rate to flash said LED array (12).

11. The apparatus according to claim 7 wherein said battery backup means (62) includes a synchronizing pulse generator means (86) connected to said d.c. power switchover and flasher means (80) for imposing marker pulses on said d.c. power at a predetermined rate.

12. An [The] apparatus [according to claim 1] for supplying regulated voltage d.c. electrical power to an LED array comprising:

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correction converter means (38) having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output;

an LED array (12) defined as consisting of series-parallel connected LED devices, having an input connected to said output of said power factor correction converter means (38) for receiving said regulated voltage d.c. power to illuminate said LED array (12); and

a half wave power detector means (88) having an input connected to said input of said rectifier means (32) and an output connected to another input of said power factor correction converter means (38), said half wave power detector means (88) being responsive to a dimming signal at said rectifier means input for generating a control signal at said half wave power detector means output and said power factor correction converter means (38) being responsive to said control signal for decreasing said regulated d.c. power to dim said LED array (12).

13. The [An] apparatus [according to claim 1] for supplying regulated voltage d.c. electrical power to an LED array comprising:

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correction converter means (38) having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output;

an LED array (12) defined as consisting of series-parallel connected LED devices, having an input connected to said output of said power factor correction converter means (38) for receiving said regulated voltage d.c. power to illuminate said LED array (12); and

a pulse width modulated modulator means (46) connected to said output of said power factor correction converter means (38) and to said input of said LED array (12) for modulating

said regulated voltage d.c. power and a half wave power detector means (88) having an input connected to said input of said rectifier means (32) and an output connected to an input of said pulse width modulated modulator means (46), said half wave power detector means being responsive to a dimming signal said rectifier means input for generating a control signal at said half wave power detector means output and said pulse width modulated modulator means (46) being responsive to said control signal for decreasing said regulated d.c. power to dim said LED array (12).

14. An apparatus for supplying regulated voltage d.c. electrical power to an LED array comprising:

a power supply means (10) having an input and an output, said power supply means (10) being responsive to a.c. power at said input for generating regulated voltage d.c. power at said output to illuminate an LED array (12) connected to said power supply means output; and

a dimming detector means (88) having an input connected to said input of said power supply means (10) and an output connected to another input of said power supply means (10), said dimming detector means (88) being responsive to a dimming signal at said power supply means input for generating a control signal at said dimming detector means output and said power supply means (10) being responsive to said control signal for decreasing said regulated voltage d.c. power to dim the LED array (12).

15. The apparatus according to claim 14 wherein said dimming detector means (88) is a half wave power detector means, said dimming signal is half wave rectified a.c. power and said power supply means (10) includes a rectifier means (32) having an input connected to said power supply means input and an output and a power factor correction converter means (38) having an

input connected to said rectifier means output and an output connected to said power supply output, said power factor correction converter means (38) including said another input of said power supply means (10), said power factor correction converter means (38) being responsive to said control signal for decreasing said regulated voltage d.c. power to dim the LED array (12).

16. The apparatus according to claim 14 wherein said dimming detector means (88) is a half wave power detector means. said dimming signal is half wave rectified a.c. power and including a pulse width modulated modulator means (46) connected to said output of said power supply means (10) for modulating said regulated voltage d.c. power, said pulse width modulated modulator means (46) including said another input of said power supply means (10), said pulse width modulated modulator means (46) being responsive to said control signal for decreasing said regulated voltage d.c. power to dim the LED array (12).

17. An apparatus for supplying regulated voltage d.c. electrical power to an LED array comprising:

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correction converter means (38) having an input connected to said output of said rectifier means (32) and an output, said power factor correction converter means (38) being responsive to said rectified d.c. power at said power factor correction converter means input for generating regulated voltage d.c. power at said power factor correction converter means output;

a battery backup means (62) having an input for receiving a.c. power applied to said input of said rectifier means (32) and having an output at which d.c. power is generated; and

a switch-over means (82) connected to said output of said battery backup means (62) and to said input of said rectifier means (32), said battery backup means (62) being responsive to a failure of a.c. power at said battery backup means input for controlling said switchover means (82) to connect said battery backup means output to said rectifier means input to provide d.c. power to said power factor correction converter means (38) to illuminate an LED array connected to said output of said power factor correction converter means (38) and being responsive to a.c. power at said battery backup means input for controlling said switch-over means (82) to disconnect said battery backup means output from said rectifier means input.

18. The apparatus according to claim 17 wherein said power factor correction converter means (38) is a power factor correcting and voltage regulating buck/boost switchmode converter.

19. The apparatus according to claim 17 including an adaptive clamp circuit means (24) connected to said input of said rectifier means (32) for eliminating leakage current problems, said adaptive clamp circuit means (24) having an input adapted to be connected to a pair of a.c. power lines (22), a pair of clamp circuit output lines (26) connected to said adaptive clamp circuit means input, a voltage sensing means (48) connected across said adaptive clamp circuit means input, and a controlled load means (50) connected across said clamp circuit output lines (26) and to said voltage sensing means (48), said voltage sensing means (48) being responsive to a magnitude of a.c. voltage at said adaptive clamp circuit means input lower than a predetermined magnitude for turning on said controlled load means (50) to connect a low impedance load (60) in said controlled load means (50) across said clamp circuit output lines (26) and said voltage sensing means (48) being responsive to a magnitude of the a.c. voltage at said adaptive clamp circuit means input equal to or greater than said predetermined magnitude for turning off said

controlled load means (50) to disconnect said low impedance load (60) from said clamp circuit output lines (26).

20. The apparatus according to claim 17 wherein said battery backup means (62) includes a time delay and restoration means (78) responsive to application of a.c. power at said input of said battery backup means (62) for controlling said switch-over means (82) to disconnect said output of said battery backup means (62) from said input of said rectifier means (32) and connect the a.c. power to said rectifier means input after a predetermined time delay.

21. The apparatus according to claim 17 wherein said battery backup means (62) includes a d.c. power switch-over and flasher means (80) connected to said switch-over means (82) for pulsing said d.c. power at a predetermined rate to flash said LED array (12).

22. The apparatus according to claim 17 wherein [Wherein] said battery backup means (62) includes a synchronizing pulse generator means (86) connected to said d.c. power switch-over and flasher means (80) for imposing marker pulses on said d.c. power at a predetermined rate.

23. An apparatus for supplying regulated voltage d.c. electrical power to an LED array comprising:

a rectifier means (32) having an input and an output, said rectifier means (32) being responsive to a.c. power at said input for generating rectified d.c. power at said output;

a power factor correcting and voltage regulating buck/boost switchmode converter (38) having an input connected to said output of said rectifier means (32) and an output, said switchmode converter (38) being responsive to said rectified d.c. power at said switchmode

converter input for generating regulated voltage d.c. power at said switchmode converter output;

an LED array (12) having an input connected to said output of said switchmode converter (38) for receiving said regulated voltage d.c. power to illuminate said LED array (12);

a battery backup means (62) having an input for receiving a.c. power applied to said input of said rectifier means (32) and having an output at which d.c. power is generated; and

a switch-over means (82) connected to said output of said battery backup means (62) and to said input of said rectifier means (32), said battery backup means (62) being responsive to a failure of a.c. power at said battery backup means input for controlling said switchover means (82) to connect said battery backup means output to said rectifier means input to provide d.c. power to said switchmode converter (38) to illuminate said LED array (12) and being responsive to a.c. power at said battery backup means input for controlling said switch-over means (82) to disconnect said battery backup means output from said rectifier means input.

24. (Currently amended) A power supply assembly for powering light emitting diodes (LEDs) in an outdoor line-connected signal, comprising:

an electrical input for coupling to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range with a lower limit voltage sufficient to activate the LEDs when the switch is on;

a rectifier coupled to the electrical input and having a rectifier output;

a line voltage regulating switchmode power supply having a power supply input coupled to the rectifier output and a power supply output;

a plurality of LEDs coupled to the power supply output and having multiple current paths for emitting light in response to the power supply output; and

a conflict monitor compatibility circuit including a low impedance load and a transistor in series connection with the low impedance load, the transistor being biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is at or above the operating range lower limit voltage and an essentially conductive condition if the electrical input voltage drops to a predetermined value below the operating range lower limit voltage, wherein:

the transistor in the essentially nonconductive condition prevents dissipation of power from the power supply output through the low impedance load whenever the electrical input voltage is within the operating range, and

the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

25. to 27. (Canceled)

28. (Currently amended) A power supply assembly for powering light emitting diodes (LEDs) in an outdoor line-connected signal, comprising:

an electrical input for coupling to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range with a lower limit voltage sufficient to activate the LEDs when the switch is on;

a rectifier coupled to the electrical input and having a rectifier output;

a switchmode power supply for maintaining current and voltage waveforms substantially in phase and for providing a regulated current output with respect to variations in the input line voltage, the power supply having a power supply input coupled to the rectifier output and a power supply output;

a plurality of LEDs coupled to the power supply output and having multiple current paths for emitting light in response to the power supply output; and

a conflict monitor compatibility circuit including a low impedance load and a transistor in series connection with the low impedance load, the transistor being biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is at or above the operating range lower limit voltage and an essentially conductive condition if the electrical input voltage drops to a predetermined value below the operating range lower limit voltage, wherein:

the transistor in the essentially nonconductive condition prevents dissipation of power from the power supply output through the low impedance load whenever the electrical input voltage is within the operating range, and

the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

29. to 31. (Canceled)

32. (Currently amended) A power supply assembly for powering light emitting diodes (LEDs) in an outdoor line-connected signal, comprising:

an electrical input for coupling to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range with a lower limit voltage sufficient to activate the LEDs when the switch is on;

a rectifier coupled to the electrical input and having a rectifier output;

a switchmode power supply for improving poor power factor, whereby the power supply provides essentially constant current at a power supply output with respect to variations in line

voltage input, and whereby current and voltage waveforms are maintained substantially in phase, the power supply having a power supply input coupled to the rectifier output and a power supply output;

a plurality of LEDs coupled to the power supply output and having multiple current paths for emitting light in response to the power supply output; and

a conflict monitor compatibility circuit including a low impedance load and a transistor in series connection with the low impedance load, the transistor being biased as a switch having an essentially nonconductive condition whenever the electrical input voltage is at or above the operating range lower limit voltage and an essentially conductive condition if the electrical input voltage drops to a predetermined value below the operating range lower limit voltage, wherein:

the transistor in the essentially nonconductive condition prevents dissipation of power from the power supply output through the low impedance load whenever the electrical input voltage is within the operating range, and

the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

33. to 36. (Canceled)

37. (Previously presented) The assembly according to claim 24, 28 or 32 wherein the switchmode power supply comprises an integrated circuit power supply.

38. (Previously presented) The assembly of claim 37 wherein the integrated circuit power supply comprises a power factor correcting switchmode converter integrated circuit.

39. and 40. (Canceled)

41. (Previously presented) The assembly according to claim 24, 28 or 32 wherein the plurality of LEDs comprise a plurality of series-parallel connected LEDs arranged in strings.

42. (Previously presented) The assembly according to claim 41 wherein the plurality of LEDs comprise a ballast resistor in each string.

43. (Canceled)

44. (Currently amended) A conflict monitor compatibility circuit for use in traffic and pedestrian signaling applications, comprising:

a plurality of LEDs for emitting light in response to an electrical input adapted to be coupled to a source of a.c. line voltage through a solid state traffic controller switch for providing an electrical input voltage having an operating range with a lower limit voltage sufficient to activate the LEDs when the switch is on;

a transistor biased as a switch that has an essentially nonconductive condition whenever the electrical input voltage is at or above the operating range lower limit voltage and an essentially conductive condition if the electrical input voltage drops to a predetermined value below the operating range lower limit voltage; and

a low impedance load in series connection with the transistor, wherein:

the transistor in the essentially nonconductive condition prevents dissipation of power through the low impedance load whenever the electrical input voltage is within the operating range, and

the transistor in the essentially conductive condition couples the low impedance load to the electrical input for shunting leakage current from the solid state traffic controller switch when the switch is off.

45. (Canceled)

46. (Previously presented) The assembly according to claim 24, 28, or 32, wherein the conflict monitor compatibility circuit further includes a sensor for providing a control output if the electrical input voltage drops below the predetermined value and a control element for switching the transistor to the essentially conductive condition in response to the control output.

47. (Previously presented) The assembly according to claim 46, wherein the sensor is a Zener diode that conducts in a reverse direction only at voltages above the predetermined value.

48. (Previously presented) The assembly according to claim 47, wherein the control element is a second transistor biased as a switch and having a base coupled to the Zener diode.

49. (Previously presented) The assembly according to claim 24, 28, or 32, further comprising an electromagnetic interference filter coupled to the power supply for preventing conducted interference from feeding back onto the a.c. line.

50. (Previously presented) The assembly according to claim 24, 28, or 32, further comprising a traffic, pedestrian or rail crossing signal housing enclosing the assembly.

51. (Previously presented) The conflict monitor compatibility circuit according claim 44, further comprising a sensor for providing a control output if the electrical input voltage drops

below the predetermined value and a control element for switching the transistor to the essentially conductive condition in response to the control output.

52. (Previously presented) The conflict monitor compatibility circuit according to claim 51, wherein the sensor is a Zener diode that conducts in a reverse direction only at voltages above the predetermined value.

53. (Previously presented) The conflict monitor compatibility circuit according to claim 52, wherein the control element is a second transistor biased as a switch and having a base coupled to the Zener diode.